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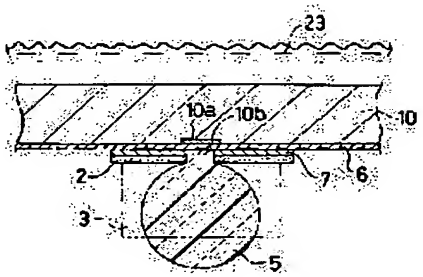
(54) METHOD FOR MANUFACTURING RESIN MICROLENS AND LIGHT RECEIVING AND EMITTING ELEMENT HAVING THE RESIN MICROLENS

(57)Abstract:

PROBLEM TO BE SOLVED: To solve the problems that in a conventional method for manufacturing a resin microlens on a substrate of light receiving and emitting elements, only a convex lens, less than hemispherical, can be manufactured and that the lens has insufficient converging power and results in extremely low use efficiency of light.

SOLUTION: The resin microlens is manufactured by melting and hardening in a liquid 23 having appropriately low specific gravity than that of a resist film 3 consisting of a photoreactive thermosetting resin while keeping the substrate 10 of light receiving and emitting elements with the light receiving and emitting part 10a facing downward. Moreover, an annular film 2 having liquid (water) repellency made of a member having water repelling property is formed on the melted state of the resist film 3 around the light receiving and emitting part 10a so that an almost spherical microlens can be accurately formed on the light receiving and emitting part 10a.



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CLAIMS

[Claim(s)]
[Claim 1] The first process which carries out patterning of the photoresist for masking which masks the part which becomes unnecessary to membrane formation by the film which has the ****(water) nature to the periphery of the carrier light-emitting part performed at the process which continues on a carrier light emitting device substrate with a HOTORISO means, The second process which forms the film of said carrier light emitting device containing the part in which said photoresist for masking was prepared which has ****(water) nature on the whole surface mostly, The third process to which it removes including the membranous membrane formation which has the ****(water) nature in which said photoresist for masking was prepared on the top face of this photoresist for masking, and the remainder only of the need part is carried out, The fourth process made to adhere with a HOTORISO means suitably in the location corresponding to said light sensing portion by making optimum dose of photoreaction nature heat-curing resin into a configuration, The fifth process which immerses for it and heats said carrier light emitting device substrate in immersion fluid with light specific gravity in the condition of making said carrier light-emitting part into facing down, more suitably than said photoreaction nature heat-curing resin, and performs formation and immobilization of a lens configuration, The manufacture approach of the resin micro lens characterized by consisting of the sixth process which removes said immersion fluid from said carrier light emitting device substrate taken out out of said immersion fluid.
[Claim 2] The carrier light emitting device characterized by having the resin micro lens obtained by the manufacture approach of above-mentioned claim 1.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a detail at the manufacture approach of the resin micro

lens about the resin micro lens prepared at said carrier light-emitting part, in order to take out outside efficiently, without carrying out stripping of the luminescence from said light-emitting part in the carrier luminescence array in which the carrier light-emitting part of a carrier light emitting device chip or the carrier light-emitting part of plurality [top / one carrier light emitting device substrate] is formed, or in order to make it converge on a light sensing portion efficiently.

[0002]

[Description of the Prior Art] It is drawing 10 - drawing 11 which show the manufacture approach of this conventional kind of resin micro lens 80, and the example when carrying out to the LED substrate 90 with which two or more light-emitting part 90a is prepared shows here. first -- as the first process -- HOTORISO (phot lithography) -- law etc. -- each light-emitting part 90a -- a wrap -- the photoresist film 91 is formed like by the thermosetting transparence member which has photoreaction nature.

[0003] after an appropriate time -- the above-mentioned photoresist film 91 -- the LED substrate 90 -- if it heats to proper temperature together, this photoresist film 91 will once be fused and will liquefy, and if it becomes the shape of a lens of the crown with surface tension as shown in drawing 11 , and this condition is maintained and heating is continued further, said photoresist film 91 will heat-harden as a lens configuration.

[0004] Therefore, if the configuration of location precision and the photoresist film 91 and thickness to light-emitting part 90a when forming said photoresist film 91, the temperature when heating further, etc. are managed to a precision, each light-emitting part 90a will be equipped with the resin micro lens 80 of a uniform optical property. Therefore, the light from each light-emitting part 90a becomes that which is converged on the same conditions, and is suitable for applications, such as a write-in head of the LED printer as which homogeneity is required.

[0005]

[Problem(s) to be Solved by the Invention] However, it sets to the above mentioned manufacture approach of the conventional resin micro lens 80. The curvature more than climax by the surface tension of the member in which the configuration of the resin micro lens 80 obtained forms the photoresist film 91 is what is not obtained. Although it becomes the curvature below hemispherical as a result, and a focal distance is long, and convergence is performed by the resin micro lens 80 as shown in drawing 12 , the light from light-emitting part 90a It is still stripping light, for example, cannot introduce into an optical fiber etc. efficiently, but the available quantity of light turns into at most about 10% of the amount of luminescence from said light-emitting part 90a, and has produced the trouble that effectiveness is low.

[0006]

[Means for Solving the Problem] As a concrete means for solving the above-mentioned technical problem, this invention The first process which carries out patterning of the photoresist for masking which masks the part which becomes unnecessary to membrane formation by the film which has the ****(water) nature to the periphery of the carrier light-emitting part performed at the process which continues on a carrier light emitting device substrate with a HOTORISO means, The second process which forms the film of said carrier light emitting device containing the part in which said photoresist for masking was prepared which has ****(water) nature on the whole surface mostly, The third process to which it removes including the membranous membrane formation which has the ****(water) nature in which said photoresist for masking was prepared on the top face of this photoresist for masking, and the remainder only of the need part is carried out, The fourth process made to adhere with a HOTORISO means suitably in the location corresponding to said light sensing portion by making optimum dose of photoreaction nature heat-curing resin into a configuration, The fifth process which immerses for it and heats said carrier light emitting device substrate in immersion fluid with light specific gravity in the condition of making said carrier light-emitting part into facing down, more suitably than said photoreaction nature heat-curing resin, and performs formation and immobilization of a lens configuration, A technical problem is solved by offering the manufacture approach of the resin micro

lens characterized by consisting of the sixth process which removes said immersion fluid from said carrier.light emitting device substrate taken out out of said immersion fluid.
[0007]
[Embodiment of the Invention] Below, this invention is explained to a detail based on the operation gestalt shown in drawing. Although it explains as that by which two or more carrier light-emitting part 10a is prepared on one substrate as what is shown in drawing 1 - drawing 6 shows the manufacture approach of the resin micro lens 5 concerning this invention in order of a process and the carrier light emitting device substrate 10 is shown in drawing 1 (A) also in this operation gestalt Naturally operation is possible also to the carrier light emitting device substrate 10 with which this invention does not limit this and only one carrier light-emitting part 10a is prepared. Moreover, as shown in drawing 1 (B), said carrier light-emitting part 10a side can be similarly carried out to the carrier light emitting device substrate 10 with which it is prepared in the bonnet transparence insulator layer 6.
[0008] Drawing 2 is the first process of the manufacture approach of the resin micro lens 5 concerning this invention. At this first process Since the film 2 which prepares for the membrane formation (the film 2 which has ****(water) nature is called hereafter) by the member which has the ****(water) nature in the second continuing process, and has this ****(water) nature makes it require only of the periphery of light-emitting part 10a of said LED substrate 10 It is the patterning process of the photoresist 1 for masking not to form the film 2 which has ****(water) nature into the part which becomes unnecessary.
[0009] HOTORISO which becomes what the same precision also as the precision of this photoresist 1 for masking is required as, therefore makes the criteria of positioning said light-emitting part 10a since the film 2 which has said ****(water) nature serves as an element important for positioning to light-emitting part 10a of the resin micro lens 5 etc. here -- it is formed by law etc. In addition, although this operation gestalt explains the photoresist 1 for masking as the shape of a ring which encloses carrier light-emitting part 10a, it is good also as other configurations, such as the shape of an ellipse which encloses carrier light-emitting part 10a, for example.
[0010] Drawing 3 (A) shows the second process and coat 2a is formed by the whole surface by vacuum evaporationo of the member which has ****(water) nature, such as fluorocarbon, in the field by the side of carrier light-emitting part 10a of the carrier light-emitting part component substrate 10 with which the photoresist 1 for masking was formed as mentioned above, including the part to which said photoresist 1 for masking was given, or sputtering. In addition, what is necessary is to form a light-shielding film 7 first to a position with the thin film of a metal member etc., then just to form coat 2a on that light-shielding film in this case, as shown in drawing 3 (B) although there are some in which carrier light-emitting part 10a is surrounded in the carrier light emitting device substrate 10, and a light-shielding film is prepared.
[0011] Drawing 4 shows the third process and removes the above-mentioned photoresist 1 for masking with proper means, such as the dissolution with a solvent. The solvent used for the dissolution of the photoresist 1 for masking at this time chooses what does not have a solvent action to said coat 2a. The film 2 which a need part becomes what carries out the remainder on the carrier light-emitting part component substrate 10 from said coat 2a, namely, has ****(water) nature by doing in this way is obtained. Here, it is only the lens fixed part which performs adhesion of the resin micro lens which explains later what is shown by sign 10b all over drawing, and immobilization.
[0012] It is arrangement of the photoreaction nature heat-curing resin 3 which drawing 5 shows the fourth process, heats this fourth process at a next process, and acquires a lens configuration. This photoreaction nature heat-curing resin 3 Since it participates in the engine performance when considering as the resin micro lens 5 according to a next process etc. greatly While raising precision to the alignment to said carrier light-emitting part 10a by the HOTORISO method, it considers as what has a uniform amount, a uniform configuration, etc., and it considers so that the resin micro lens 5 of the uniform engine performance may be obtained by the focal distance etc.
[0013] Although drawing 6 and drawing 7 show the fifth process of this invention, shall heat

photoreaction nature heat-curing resin 3, and should carry out melting in atmospheric air conventionally and the lens configuration should have been acquired, in this invention, heating of photoreaction nature heat-curing resin 3 shall be performed in a liquid. Furthermore, in addition, in case it heats conventionally, although said carrier light-emitting part component substrate 10 was performed considering the field side in which carrier light-emitting part 10a was prepared as the upper part, it is performed as a lower part by this invention.

[0014] Drawing 6 shows the hot bath tub 20 used for heating of the above-mentioned photoreaction nature heat-curing resin 3, this hot bath tub shall consist of a hot plate 21, a vat 22, and the silicone oil 23 held in said vat 22, and adjustment of a hot plate 21 shall adjust the solution temperature of a silicone oil 23 free.

[0015] Here, if the situation when heating by making into a lower part the side by which said carrier light-emitting part component substrate 10 was formed in carrier light-emitting part 10a is considered, since said photoreaction nature heat-curing resin 3 is once liquefied with heating, dropping will be produced with gravity and it will become what hardly carries out the remainder on the carrier light-emitting part component substrate 10.

[0016] Therefore, since it heats in said silicone oil 23 and this silicone oil 23 is considering as what has slightly light specific gravity rather than said photoreaction nature heat-curing resin 3 in order to prevent the above-mentioned situation in this invention While preventing dropping with viscosity, surface tension, etc. which give a proper buoyancy to liquefied photoreaction nature heat-curing resin 3, and this photoreaction nature heat-curing resin 3 has At least the lens fixed part of photoreaction nature heat-curing resin 3 makes the part except 10b exfoliate from the carrier light-emitting part component substrate 10 with the film 2 which has ****(water) nature, and it controls to give a lens configuration.

[0017] Drawing 7 is what shows the condition of heating of the photoreaction nature heat-curing resin 3 in the above-mentioned silicone oil 23 which is the fifth process of this invention. In this invention Since the film 2 which has ****(water) nature is beforehand formed in the periphery of said carrier light-emitting part 10a, the part located in the upper part of the film 2 which has ****(water) nature after said photoreaction nature heat-curing resin 3 liquefied is crawled, and exfoliation is performed. In addition, although illustrated in the condition that the transparence insulator layer 6 shown in drawing 1 (B) in drawing 7 and the light-shielding film 7 shown in drawing 3 (B) exist, it cannot be overemphasized that it is a thing also including the condition that this invention does not have any [both the film 6 and 7 or] of those they are.

[0018] And since said photoreaction nature heat-curing resin 3 is what receives only slight gravity according to a specific gravity difference with a silicone oil 23, a configuration is changed to the globular form to which surface tension excels and surface area serves as min from gravity. Therefore, if the temperature of a silicone oil 23 is further raised suitably in the condition of having become spherical [the above], hardening of photoreaction nature heat-curing resin 3 is promoted, the shape of an above ball will be maintained, hardening will be performed, and the resin micro lens 5 by this invention will be obtained.

[0019] Therefore, after the above-mentioned hardening is completed, washing according to toluene, an acetone, etc. considering the carrier light-emitting part component substrate 10 as ejection and the sixth process is performed out of a silicone oil 23, and if the silicone oil 23 adhering to said carrier light-emitting part component substrate 10 and the resin micro lens 5 is removed, the carrier light-emitting part component substrate 10 equipped with the resin micro lens 5 shown in drawing 8 will be obtained.

[0020] If the operation effectiveness of the carrier light-emitting part component substrate 10 equipped with the resin micro lens 5 obtained by the above-mentioned manufacture approach here is explained, since it will be made to said carrier light-emitting part 10a with that to which the approximate spherical resin micro lens 5 is attached, the light which carrier light-emitting part 10a emits is completed ahead of [proper] said resin micro lens 5, as shown in drawing 9 , and it becomes possible to make Focus f connect.

[0021] If this becomes the thing of the quantity of light which carrier light-emitting part 10a emits which all converge on Focus f mostly, for example, opening of an optical fiber is located near said focus f, it will become possible [almost incorporating the total quantity of light in an optical fiber], and its effectiveness will improve by leaps and bounds.
[0022] moreover, arrangement of a up to [the carrier light-emitting part component substrate 10 of said photoreaction nature heat-curing resin 3] etc. -- HOTORISO -- it becomes that by which the temperature conditions over each photoreaction nature heat-curing resin 3 etc. are equalized by heating the photoreaction nature heat-curing resin 3 when carrying out by law and acquiring a lens configuration in a silicone oil 23, and variation between the resin micro lenses 5 is also made small.
[0023] Moreover, it sets for applications, such as an LED printer head used in order to write an alphabetic character, a graphic form, etc. in a photo conductor (drum). By having become what has Focus f as mentioned above, it becomes possible to fill in a photo conductor directly by this focus f. The optical fiber lens which was required in order to make a focus connect to said photo conductor conventionally is made unnecessary, and the cost cut of the whole device by which this kind of carrier light-emitting part component substrate 10 is adopted is also enabled.
[0024]
[Effect of the Invention] The first process which carries out patterning of the photoresist for masking which masks the part which becomes unnecessary by this invention to membrane formation by the film which has the ****(water) nature to the periphery of the carrier light-emitting part performed at the process which continues on a carrier light emitting device substrate as explained above with a HOTORISO means, The second process which forms the film of said carrier light emitting device containing the part in which said photoresist for masking was prepared which has ****(water) nature on the whole surface mostly, The third process to which it removes including the membranous membrane formation which has the ****(water) nature in which said photoresist for masking was prepared on the top face of this photoresist for masking, and the remainder only of the need part is carried out, The fourth process made to adhere with a HOTORISO means suitably in the location corresponding to said light sensing portion by making optimum dose of photoreaction nature heat-curing resin into a configuration, The fifth process which immerses for it and heats said carrier light emitting device substrate in immersion fluid with light specific gravity in the condition of making said carrier light-emitting part into facing down, more suitably than said photoreaction nature heat-curing resin, and performs formation and immobilization of a lens configuration, By having considered as the manufacture approach of the resin micro lens characterized by consisting of the sixth process which removes said immersion fluid from said carrier light emitting device substrate taken out out of said immersion fluid While making it possible to install the resin micro lens of various configurations, such as the shape of a true ball, in a carrier light-emitting part in the precision of HOTORISO level and raising the flux of light utilization factor at the time of the activity of this kind of carrier light-emitting part component substrate with a resin micro lens Precision is also raised and the effectiveness which was extremely excellent in the improvement in the engine performance is done so.

[Translation done.]

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the carrier light-emitting part component substrate which installs the resin micro lens concerning this invention.
[Drawing 2] It is the sectional view showing the first process of the manufacture approach of the resin micro lens concerning this invention.
[Drawing 3] It is the sectional view showing the second process similarly.
[Drawing 4] It is the sectional view showing the third process similarly.
[Drawing 5] It is the sectional view showing the fourth process similarly.
[Drawing 6] It is the sectional view showing the hot bath tub used for the fifth process.
[Drawing 7] It is the explanatory view showing the fifth process of the manufacture approach of the resin micro lens concerning this invention.
[Drawing 8] It is the sectional view showing a carrier light-emitting part component substrate equipped with the resin micro lens obtained by the manufacture approach of the resin micro lens concerning this invention.
[Drawing 9] It is the explanatory view showing an operation of a carrier light-emitting part component substrate equipped with the resin micro lens obtained by the manufacture approach of the resin micro lens concerning this invention.
[Drawing 10] It is the sectional view showing the first process of the conventional example.
[Drawing 11] It is the sectional view showing the second process of the conventional example.
[Drawing 12] It is the explanatory view showing an operation of the carrier light-emitting part component substrate with a micro lens of the conventional example.
[Description of Notations]
1 .... Photoresist for masking
2 .... Film which has ****(water) nature
3 .... Photoreaction nature heat-curing resin
5 .... Resin micro lens
6 .... Transparence insulator layer
7 .... Light-shielding film
10 .... Carrier light-emitting part component substrate
10a .... Carrier light-emitting part
10b .... About a lens fixed part
20 .... Hot bath tub
21 .... Hot plate
22 .... Vat
23 .... Silicone oil

[Translation done.]

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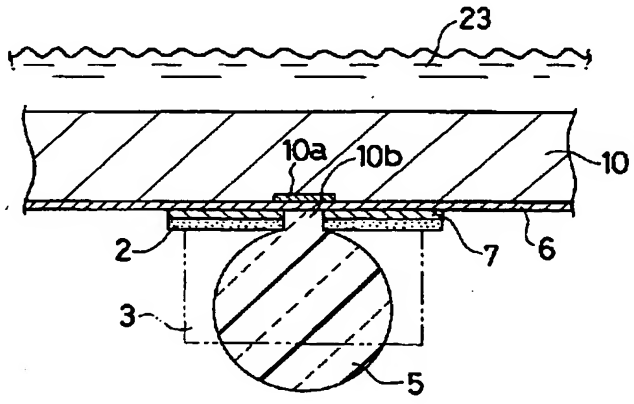
(54)【発明の名称】　樹脂マイクロレンズの製造方法および該樹脂マイクロレンズを備える受発光素子

(57)【要約】
【課題】　従来の受発光部素子基板上への樹脂マイクロレンズの製造方法では半球状に満たない凸レンズしか製造できず、収束力が不足して光量の利用効率が極めて低いという問題点を生じていた。
【解決手段】　本発明により溶融と硬化とを光反応性熱硬化樹脂によるレジスト膜２よりも適宜に比重の軽い液体２３中で、且つ、受発光部素子基板１０を受発光部１０ａを下向きとする状態で行う樹脂マイクロレンズの製造方法とし、加えて、受発光部１０ａの周縁には溶融した状態のレジスト膜２に対し撥水性を有する部材で形成された略リング状の撥液（水）性を有する膜２を設けることで、ほぼ真球状のマイクロレンズを正確に受発光部１０ａに設けることを可能とし課題を解決するものである。



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【特許請求の範囲】

【請求項１】　受発光素子基板上に続く工程で行われる受発光部の周縁への撥液（水）性を有する膜による成膜に対し不要となる部分をマスキングするマスキング用ホトレジストをホトリソ手段によりパターニングする第一工程と、前記マスキング用ホトレジストが設けられた部分を含む前記受発光素子のほぼ全面に撥液（水）性を有する膜の成膜を行う第二工程と、前記マスキング用ホトレジストをこのマスキング用ホトレジストの上面に設けられた撥液（水）性を有する膜の成膜を含み除去し必要部分のみを残余させる第三工程と、前記受光部に対応する位置に光反応性熱硬化樹脂の適量を適宜形状としてホトリソ手段により付着させる第四工程と、前記受発光素子基板を前記光反応性熱硬化樹脂よりも適宜に比重の軽い浸漬液中に前記受発光部を下向きとする状態で浸漬して加熱しレンズ形状の形成と固定化とを行う第五工程と、前記浸漬液中から取り出した前記受発光素子基板から前記浸漬液を除去する第六工程とから成ることを特徴とする樹脂マイクロレンズの製造方法。

【請求項２】　上記請求項１の製造方法により得られる樹脂マイクロレンズを備えることを特徴とする受発光素子。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、受発光素子チップの受発光部、或いは、１枚の受発光素子基板上に複数の受発光部が設けられる受発光アレイなどにおいて、前記発光部からの発光を放散させることなく効率よく外部に取り出すため、或いは、効率よく受光部に収束させるために、前記受発光部に設けられる樹脂マイクロレンズに関するものであり、詳細にはその樹脂マイクロレンズの製造方法に係るものである。

【０００２】

【従来の技術】従来のこの種の樹脂マイクロレンズ８０の製造方法を示すものが図１０～図１１であり、ここでは複数の発光部９０ａが設けられているＬＥＤ基板９０に実施するときの例で示す。まず、第一工程として、ホトリソ（ホトリソグラフィ）法などでそれぞれの発光部９０ａを覆うように、光反応性を有する熱硬化性の透明部材によりホトレジスト膜９１を形成する。

【０００３】しかる後に、上記ホトレジスト膜９１をＬＥＤ基板９０ともども、適宜な温度に加熱すると、このホトレジスト膜９１は一旦溶融し液状化し、図１１に示すように表面張力により中高のレンズ状となり、この状態を保ち更に加熱を継続すると、前記ホトレジスト膜９１はレンズ形状として熱硬化するものとなる。

【０００４】よって、前記ホトレジスト膜９１を形成するときの発光部９０ａに対する位置精度、ホトレジスト膜９１の形状および膜厚、更には加熱するときの温度などを精密に管理すれば、各発光部９０ａには均一な光学

2

特性の樹脂マイクロレンズ８０が備えられるものとなる。従って、それぞれの発光部９０ａからの光は同じ条件で収束するものとなり、均一性が要求されるＬＥＤプリンタの書き込みヘッドなどの用途に適するものとなる。

【０００５】

【発明が解決しようとする課題】しかしながら、前記した従来の樹脂マイクロレンズ８０の製造方法においては、得られる樹脂マイクロレンズ８０の形状が、ホトレジスト膜９１を形成する部材の表面張力による盛り上がり以上の曲率は得られないものであり、結果的には半球状以下の曲率となり焦点距離が長く、図１２に示すように発光部９０ａからの光は樹脂マイクロレンズ８０により収束は行われるものの、依然として放散光であり、例えば光ファイバーなどに効率よく導入を行うことができず、利用可能な光量は前記発光部９０ａからの発光量のたかだか１０％程度となり、効率が低い問題点を生じている。

【０００６】

【課題を解決するための手段】本発明は上記した課題を解決するための具体的手段として、受発光素子基板上に続く工程で行われる受発光部の周縁への撥液（水）性を有する膜による成膜に対し不要となる部分をマスキングするマスキング用ホトレジストをホトリソ手段によりパターニングする第一工程と、前記マスキング用ホトレジストが設けられた部分を含む前記受発光素子のほぼ全面に撥液（水）性を有する膜の成膜を行う第二工程と、前記マスキング用ホトレジストをこのマスキング用ホトレジストの上面に設けられた撥液（水）性を有する膜の成膜を含み除去し必要部分のみを残余させる第三工程と、前記受光部に対応する位置に光反応性熱硬化樹脂の適量を適宜形状としてホトリソ手段により付着させる第四工程と、前記受発光素子基板を前記光反応性熱硬化樹脂よりも適宜に比重の軽い浸漬液中に前記受発光部を下向きとする状態で浸漬して加熱しレンズ形状の形成と固定化とを行う第五工程と、前記浸漬液中から取り出した前記受発光素子基板から前記浸漬液を除去する第六工程とから成ることを特徴とする樹脂マイクロレンズの製造方法を提供することで課題を解決するものである。

【０００７】

【発明の実施の形態】つぎに、本発明を図に示す実施形態に基づいて詳細に説明する。図１～図６に示すものは、本発明に係る樹脂マイクロレンズ５の製造方法を工程の順に示すものであり、この実施形態においても受発光素子基板１０は、図１（Ａ）に示すように１枚の基板上に複数の受発光部１０ａが設けられているものとして説明を行うが、本発明はこれを限定するものではなく、１つの受発光部１０ａのみが設けられている受発光素子基板１０に対しても、当然に実施は可能である。また、図１（Ｂ）に示すように前記受発光部１０ａ側を覆い透

明絶縁膜６が設けられている受発光素子基板１０に対しても同様に実施が可能である。

【０００８】図２は本発明に係る樹脂マイクロレンズ５の製造方法の第一工程であり、この第一工程では、続く第二工程での撥液（水）性を有する部材による成膜（以下、撥液（水）性を有する膜２と称する）に備え、この撥液（水）性を有する膜２が前記ＬＥＤ基板１０の発光部１０ａの周縁にのみ要求させるものであるので、不要となる部分に撥液（水）性を有する膜２が形成されないようにするためのマスキング用ホトレジスト１のパターニング工程である。

【０００９】ここで、前記撥液（水）性を有する膜２は樹脂マイクロレンズ５の発光部１０ａに対する位置決めなどに重要な要素となるものであるので、このマスキング用ホトレジスト１の精度にも同様な精度が要求されるものとなり、従って、前記発光部１０ａを位置決めの基準とするホトリソ法などで形成される。尚、この実施形態ではマスキング用ホトレジスト１は受発光部１０ａを取り囲むリング状として説明するが、例えば受発光部１０ａを取り囲む楕円状など他の形状としても良いものである。

【００１０】図３（Ａ）は第二工程を示すものであり、上記のようにしてマスキング用ホトレジスト１が設けられた受発光部素子基板１０の受発光部１０ａ側の面には、前記マスキング用ホトレジスト１が施された部分を含み、例えばフロロカーボンなど撥液（水）性のある部材の蒸着、或いは、スパッタリングにより全面に被膜２ａが成膜される。尚、受発光素子基板１０においては受発光部１０ａを取り囲み遮光膜が設けられるものもあるが、この場合には、図３（Ｂ）に示すように、金属部材の薄膜などで所定の位置に遮光膜７を最初に成膜し、続いて、その遮光膜上に被膜２ａを成膜すればよい。

【００１１】図４は第三工程を示すものであり、上記マスキング用ホトレジスト１を例えば溶剤での溶解など適宜な手段で除去する。このときにマスキング用ホトレジスト１の溶解に使用する溶剤は、前記被膜２ａに対しては溶解作用を持たないものを選択する。このようにすることで、前記被膜２ａから必要部分が受発光部素子基板１０上に残余するものとなり、即ち、撥液（水）性を有する膜２が得られるものとなる。ここで、図中に符号１０ｂで示すものは、後に説明する樹脂マイクロレンズの接着、固定を行うレンズ固定部位である。

【００１２】図５は、第四工程を示すものであり、この第四工程は後の工程で加熱しレンズ形状を得る光反応性熱硬化樹脂３の配置であり、この光反応性熱硬化樹脂３は、後の工程により樹脂マイクロレンズ５としたときの性能などに大きく関与するものであるので、ホトリソ法により前記受発光部１０ａに対する位置合わせに精度を高めると共に、量、形状なども均一なものとし、焦点距離などに均一な性能の樹脂マイクロレンズ５が得られるように配慮する。

【００１３】図６および図７は、本発明の第五工程を示すものであり、従来は大気中で光反応性熱硬化樹脂３の加熱を行い溶融させてレンズ形状を得るものとしていたが、本発明では光反応性熱硬化樹脂３の加熱は液体中で行うものとしている。更に加えて、従来は加熱を行う際に前記受発光部素子基板１０は、受発光部１０ａが設けられていた面の側を上方として行われていたが、本発明では下方として行う。

【００１４】図６は上記光反応性熱硬化樹脂３の加熱に用いる加熱浴槽２０を示すものであり、この加熱浴槽は、ホットプレート２１とバット２２と、前記バット２２中に保持されるシリコンオイル２３とから成り、ホットプレート２１の調整によりシリコンオイル２３の液温を自在に調整できるものとされている。

【００１５】ここで、前記受発光部素子基板１０を受発光部１０ａが設けられた側を下方として加熱を行うときの状況を考察してみると、前記光反応性熱硬化樹脂３は加熱により一旦液化するものであるので、重力により滴下を生じてしまい、受発光部素子基板１０上にはほとんど残余しないものとなってしまう。

【００１６】よって、本発明では上記の事態を防止するために、前記シリコンオイル２３中で加熱を行うものであり、このシリコンオイル２３は前記光反応性熱硬化樹脂３よりも僅かに比重の軽いものとしているので、液化した光反応性熱硬化樹脂３に対して適宜な浮力を与え、この光反応性熱硬化樹脂３の有する粘性、表面張力などにより滴下を防止すると共に、撥液（水）性を有する膜２により光反応性熱硬化樹脂３のレンズ固定部位１０ｂを除く部分を受発光部素子基板１０から剥離させ、レンズ形状を与えるように制御するのである。

【００１７】図７は本発明の第五工程である上記シリコンオイル２３中における光反応性熱硬化樹脂３の加熱の状態を示すものであり、本発明では、あらかじめ前記受発光部１０ａの周縁に撥液（水）性を有する膜２を形成してあるので、前記光反応性熱硬化樹脂３が液化した後には撥液（水）性を有する膜２の上部に位置していた部分は、はじかれて剥離が行われる。尚、図７においては図１（Ｂ）に示した透明絶縁膜６、および、図３（Ｂ）に示した遮光膜７が存在する状態で図示を行うが、本発明は両膜６、７或いはその何れかがない状態をも含むものであることは言うまでもない。

【００１８】そして、前記光反応性熱硬化樹脂３はシリコンオイル２３との比重差により僅かな重力しか受けないものとなっているので、重力よりも表面張力が勝り、表面積が最小となる球形に形状を変化させるものとなる。従って、上記の球状となった状態で更にシリコンオイル２３の温度を適宜に上昇させれば、光反応性熱硬化樹脂３の硬化は促進され、上記の球状を保ち硬化が行われ、本発明による樹脂マイクロレンズ５が得られるもの

となる。

【００１９】従って、上記の硬化が完了した後には、シリコンオイル２３中から受発光部素子基板１０を取り出し、第六工程としてトルエン、アセトンなどによる洗浄を行い、前記受発光部素子基板１０および樹脂マイクロレンズ５に付着するシリコンオイル２３の除去を行えば、図８に示す樹脂マイクロレンズ５を備える受発光部素子基板１０が得られるものとなる。

【００２０】ここで、上記の製造方法により得られる樹脂マイクロレンズ５を備える受発光部素子基板１０の作用効果を説明すれば、前記受発光部１０ａには略真球状の樹脂マイクロレンズ５が付属するものとできるので、受発光部１０ａが発する光を、図９に示すように前記樹脂マイクロレンズ５の適宜な前方に収束させ、焦点ｆを結ばせることが可能となる。

【００２１】このことは、受発光部１０ａが発する光量のほぼ全てが焦点ｆに収束するものとなり、例えば前記焦点ｆの近傍に光ファイバの開口部を位置させれば、ほとんど全光量を光ファイバ中に取り込むことが可能となり、効率が飛躍的に向上するものとなる。

【００２２】また、前記光反応性熱硬化樹脂３の受発光部素子基板１０上への配置などをホトリソ法で行い、且つ、レンズ形状を得るときの光反応性熱硬化樹脂３の加熱をシリコンオイル２３中で行うことで、それぞれの光反応性熱硬化樹脂３に対する温度条件などが均一化されるものとなり、樹脂マイクロレンズ５間におけるバラツキも僅少化されるものとなる。

【００２３】また、感光体（ドラム）に文字、図形などを書き込むために用いられるＬＥＤプリンタヘッドなどの用途においては、上記のように焦点ｆを有するものとなったことで、この焦点ｆにより直接に感光体に記入を行うことが可能となり、従来は前記感光体に焦点を結ばせるために必要であった光ファイバーレンズなどを不要とし、この種の受発光部素子基板１０が採用される機器全体のコストダウンも可能とする。

【００２４】

【発明の効果】以上に説明したように本発明により、受発光素子基板上に続く工程で行われる受発光部の周縁への撥液（水）性を有する膜による成膜に対し不要となる部分をマスキングするマスキング用ホトレジストをホトリソ手段によりパターニングする第一工程と、前記マスキング用ホトレジストが設けられた部分を含む前記受発光素子のほぼ全面に撥液（水）性を有する膜の成膜を行う第二工程と、前記マスキング用ホトレジストをこのマスキング用ホトレジストの上面に設けられた撥液（水）性を有する膜の成膜を含み除去し必要部分のみを残余させる第三工程と、前記受光部に対応する位置に光反応性熱硬化樹脂の適量を適宜形状としてホトリソ手段により付着させる第四工程と、前記受発光素子基板を前記光反応性熱硬化樹脂よりも適宜に比重の軽い浸漬液中に前記受発光部を下向きとする状態で浸漬して加熱しレンズ形状の形成と固定化とを行う第五工程と、前記浸漬液中から取り出した前記受発光素子基板から前記浸漬液を除去する第六工程とから成ることを特徴とする樹脂マイクロレンズの製造方法としたことで、真球状など種々の形状の樹脂マイクロレンズをホトリソレベルの精度で受発光部に設置することを可能とし、この種の樹脂マイクロレンズ付き受発光部素子基板の使用時の光束利用率を向上させると共に、精度も向上させ、性能向上に極めて優れた効果を奏するものである。

【図面の簡単な説明】

【図１】　本発明に係る樹脂マイクロレンズを設置する受発光部素子基板を示す断面図である。

【図２】　本発明に係る樹脂マイクロレンズの製造方法の第一工程を示す断面図である。

【図３】　同じく第二工程を示す断面図である。

【図４】　同じく第三工程を示す断面図である。

【図５】　同じく第四工程を示す断面図である。

【図６】　第五工程に使用する加熱浴槽を示す断面図である。

【図７】　本発明に係る樹脂マイクロレンズの製造方法の第五工程を示す説明図である。

【図８】　本発明に係る樹脂マイクロレンズの製造方法により得られる樹脂マイクロレンズを備える受発光部素子基板を示す断面図である。

【図９】　本発明に係る樹脂マイクロレンズの製造方法により得られる樹脂マイクロレンズを備える受発光部素子基板の作用を示す説明図である。

【図１０】　従来例の第一工程を示す断面図である。

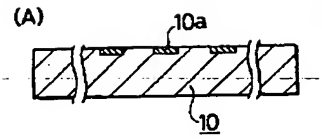
【図１１】　従来例の第二工程を示す断面図である。

【図１２】　従来例のマイクロレンズ付き受発光部素子基板の作用を示す説明図である。

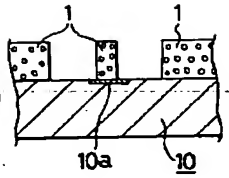
【符号の説明】

１……マスキング用ホトレジスト
２……撥液（水）性を有する膜
３……光反応性熱硬化樹脂
５……樹脂マイクロレンズ
６……透明絶縁膜
７……遮光膜
１０……受発光部素子基板
１０ａ……受発光部
１０ｂ……レンズ固定部位
２０……加熱浴槽
２１……ホットプレート
２２……バット
２３……シリコンオイル

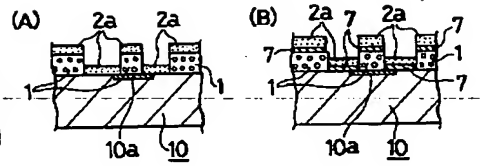
【図１】



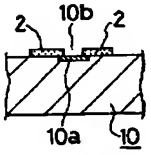
【図２】



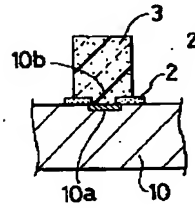
【図３】



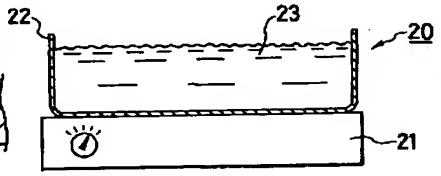
【図４】



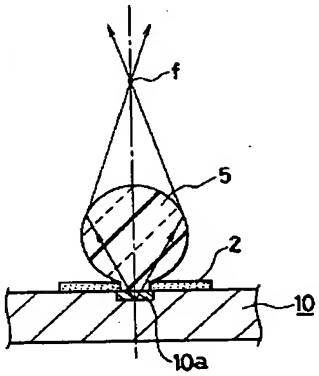
【図５】



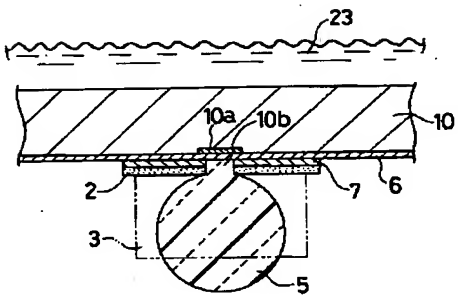
【図６】



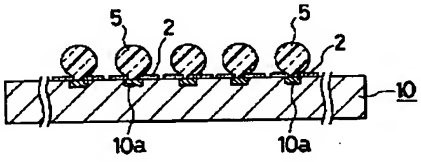
【図９】



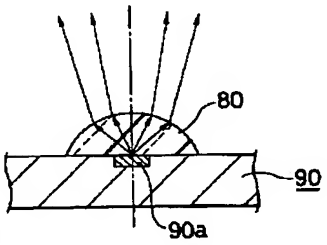
【図７】



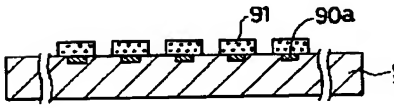
【図８】



【図１２】



【図１０】



【図１１】